

AMERICAN MUSEUM NOVITATES

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CITY OF NEW YORK OCTOBER 16, 1950 NUMBER 1467

GEOGRAPHICAL VARIATION AND SUBSPECIATION IN *HELICONIUS* *CHARITONIUS* LINNAEUS (LEPIDOPTERA, NYMPHALIDAE)

BY WILLIAM P. COMSTOCK AND F. MARTIN BROWN

INTRODUCTION

The idea of making a study of *Heliconius charitonius* arose some 10 years ago in conjunction with the study of Antillean butterflies. After some study the endeavor was abandoned for the reason that several of the samples did not seem adequate to permit of justifiable conclusions. It was determined to borrow material from other collections to increase the size of population samples. During this period of abeyance, material came into the American Museum from Mexico and Central and South America in sufficient quantity to provide samples considered to be adequate from these regions. The article, as now drafted, is based upon about twice as much material as originally available. It is prepared upon the same basis of measurement and observation as originally determined upon but with all raw data rechecked for conformity by one author.

The name *charitonia* presents an interesting problem. It was no doubt derived from *Χαίρες*, the Greek name for the Graces whom the Romans called Graciae or Charites. Linnaeus in the twelfth edition of "Systema naturae" (1767, vol. 1, pt. 2, p. 757, no. 65), described "Charithonia." However, in the same volume, in the index, "Nomina Trivialia Papilionum," he gave another reference, "Charitonia 65." This last reference carries the spelling as corrected by Linnaeus. Müller (1774) used the spelling

"Charitonia" without explanation; Linnaeus (1776) used "Papilio charitonia" and in the thirteenth edition of "Systema naturae" (1790) edited by Gmelin, the spelling is "Charitonia." If there should be any question as to the authority for the adoption here of *charitonia*, it may be pointed out that since both spellings are of the same date (p. 757 and index), the first reviser has the task of selecting one or the other; and since it is believed that no such formal selection has been made heretofore, *charitonia* is selected as the proper spelling of the name.

This well-known and widely distributed butterfly, *Heliconius charitoni* (Linnaeus), commonly called the Zebra, has been mentioned casually so many times in the literature that an exhaustive examination of references would be unprofitably time consuming. A taxonomic check was made to verify names and establish the distribution, and such references are to be found in the bibliography.

DISTRIBUTION

Heliconius charitoni is an American butterfly. In South America it is known from northern Peru, Ecuador, Colombia, and western Venezuela. Bates (1862) did not report it from the Amazon; Capronnier (1873) did not list it from Brazil; it is not mentioned by Sepp (1848) or Stoll (1787) from Surinam, but Cramer (1777) figured the species, saying that it came from North and Central America. Godman and Salvin (1879-1901) said that *Heliconius charitoni* did not occur in the Amazon Valley or Guiana but was known throughout Central America from sea level to 5000 feet elevation. The species is apparently common from Panama to northern Mexico, with reports of it from Texas. William D. Field (1938) recorded one specimen from Scott County, Kansas. Also, he reported (letter) specimens from near Brownsville, Texas, April, and Kerrville, south central Texas, July. Ralph L. Chermock (letter) said that *Heliconius* flies around Brownsville, Texas. H. A. Freeman (letter) said that he collected the species in and around Pharr, Texas, but not north of that area, and at Hidalgo, about 11 miles south of Pharr. Most specimens appeared during September, October, November, and in May.

Kaye (1921) did not report the species from Trinidad, or Longstaff (1908) from Tobago; Godman and Salvin (1896) said that *Heliconiinae* are absent in St. Vincent and Grenada; there is no

mention of *Heliconius* by Butler (1901) from St. Lucia or by Lathy (1904) from Dominica. The species is unreported in recent collections from Dominica, according to Lawrence S. Dillon (letter). In the Lesser Antilles, the most southern record is that of George Edwards (1743) from Montserrat, a specimen probably of the race described by Hall (1936) as *punctata* from St. Kitts and Antigua. The species is common in the Virgin Islands, Puerto Rico, Mona Island, Hispaniola, Jamaica, Grand Cayman Island (Carpenter and Lewis, 1943), Isle of Pines (Holland, 1916), Cuba, but Sharpe (1900) did not report *Heliconius* from the Bahamas nor are there any records known.

Heliconius charitonius is a common species in Florida, with records as far north as Gainesville. Boisduval and LeConte (1833) mentioned *charitonius* as rare from Georgia and Florida, and there is a recent record from Valdosta, Georgia, by V. Nabokov and another from Savannah by H. L. King. William D. Field (letter) reported one specimen from Jasper County, South Carolina, November. Holland (1931) said that the species occurred in the Gulf states. Ludwig von Reizenstein (1863) in his interesting little "Catalogue of the Lepidoptera of New Orleans and its vicinity" listed "24. *Heliconia charitonia*, Linn. Rare. Western lake shore."

METHODS OF STUDY

It is obvious from even superficial comparison of specimens representative of different populations that there are differences which can be defined to separate them. The divergence between individuals of a given population are also considerable so that it becomes necessary to find out in what degree one population is similar to or different from another. To accomplish this, a statistical approach based upon the raw data and not upon the methods of quantitative systematics was adopted.

In total, over one thousand specimens (table 1) were studied, from the collection of the American Museum supplemented by loans from other museums and individuals, all later acknowledged. The material was ample to give good samples representative of the diverse populations almost throughout the reported range of the species. There were no specimens from St. Kitts, Antigua, and Montserrat. Seasonal data were excellent, indicating that the butterflies in most of the different population samples were captured in every month of the year. It was thus possible to

TABLE 1
RECORD OF SPECIMENS BY POPULATIONS AND PERIODS OF FLIGHT

	♂	♀	Total	Months
Virgin Is. and Puerto Rico	77	61	138	10
Jamaica	49	28	77	5
Cuba	43	46	89	12
Hispaniola	79	74	153	11
Florida	126	100	226	12
Mexico	85	54	139	12
Central America	37	26	63	12
South America	76	22	98	7
West slope of Andes	22	17	39	2

check for seasonal variations, but this was unproductive, for there was no apparent association of intra-subspecific variability with changes of season.

Two measurements were made on each specimen, usually on the left forewing, with a vernier millimeter caliper read with a hand lens: the length of the forewing from the base to the fullest extent of the outer margin; the width of the yellow band above the inner margin, measured on the left forewing between veins as indicated in figure 1. In table 2, for the lengths of forewing

TABLE 2
RANGES OF LENGTHS OF FOREWINGS OF BOTH SEXES AND AVERAGES (IN MILLIMETERS); RANGES OF WIDTHS OF BANDS AT VEIN Cu_2 OF THE FOREWINGS AND AVERAGES (IN MILLIMETERS)

	Ranges		Averages		Ranges		Averages	
	♂	♀	♂	♀	♂	♀	♂	♀
Virgin Is. and								
Puerto Rico	33.1-44.5	34.0-45.5	37.4	40.2	1.9-3.0	2.0-3.0	2.4	2.5
Jamaica	28.0-40.7	32.0-41.6	35.9	37.0	2.0-3.4	2.4-3.6	2.7	3.0
Cuba	32.0-47.5	32.0-48.2	40.7	41.5	1.9-3.3	1.7-3.3	2.5	2.6
Hispaniola	29.4-46.0	32.4-48.5	38.6	40.8	1.5-2.6	1.4-2.8	2.1	2.2
Florida	25.2-48.5	33.5-50.0	41.6	43.2	1.0-2.9 ^a	1.4-2.4	1.8	1.9
Mexico	31.7-50.2	36.8-49.4	41.5	43.2	1.8-3.0	2.0-3.3	2.3	2.5
Central								
America	31.2-45.3	34.8-47.8	40.3	42.2	1.6-3.0	1.8-3.3	2.4	2.5
South								
America	31.1-43.0	33.6-43.2	37.6	39.7	1.8-2.8	2.1-3.0	2.3	2.4
West slope of								
Andes	29.2-37.3	31.0-41.4	33.8	36.0	2.4-3.7	2.7-4.0	3.0	3.3

^a One male 2.9 mm., next largest male 2.5 mm., next two males 2.3 mm.

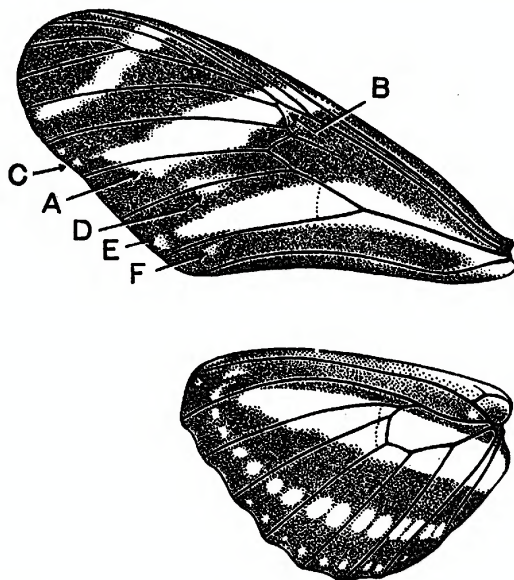


FIG. 1. Enlarged drawing identifying the critical markings of the wings of the left side of the specimen shown in figure 3A.

and widths of band, the minimum and maximum lengths and the arithmetical average of all of the specimens of each sample are

TABLE 3

OCCURRENCE OF MACULATION AS INDICATED IN FIGURE 1, BY PERCENTAGES IN VARIOUS POPULATION SAMPLES; PERCENTAGES OF RUSTY FEMALES AND INTERRUPTED BANDS

	A %	B %	C %	D %	E %	F %	Rusty ♀ %	Broken Band %
Virgin Is. and								
Puerto Rico	95.6	56.5	47.2	52.9	99.2	59.4	0	0
Jamaica	48.0	92.3	2.6	6.5	100	31.2	0	0
Cuba	47.2	87.5	34.9	14.6	100	12.4	5.6	0
Hispaniola	44.0	83.0	31.0	3.4	100	15.0	54.0	2.6
Florida	38.8	88.3	30.3	0.4	99.8	0	44.0	90.6
Mexico	15.2	94.0	22.4	1.5	100	1.5	62.0	0
Central								
America	14.2	77.0	15.8	0	100	3.1	65.3	0
South								
America	16.3	90.8	9.2	0	92.0	4.1	59.0	0
West slope of								
Andes	0	100	0	0	100	0	0	0

reported separately for each sex. The widths of bands and lengths of forewing are not in relative agreement in specimens of any population. A wide band does not always occur with a long wing or *vice versa*, but to some extent this is true.

Six characters of the maculation of the upper surface of the forewing were noted for presence or absence. These are indicated on figure 1 as bar (A), an extension of the yellow scaling below vein M_3 ; notch (B), an entry of black scaling into the yellow band at the distal end of the discal cell; spot (C), a small spot of yellow scales at the margin in cell M_2 ; spot (D), a spot of yellow scales lying over vein Cu_1 ; spot (E), a marginal spot of yellow scales in cell Cu_1 ; spot (F), a spot of yellow scales in cell Cu_2 . Table 3 records by percentages the occurrence of these markings in each population sample. These characters are variable in intensity, sometimes prominent, again appearing as traces, but if occurring to any degree they were counted as present. Other variable characters can be found, notably the width of the yellow band of the hind wing, but the characters noted, all on the forewing, are sufficient to define the differences between the various populations.

The following characters were noted for each specimen and tabulated (see tables 1 and 4): the sex; the presence or absence of rusty scales overlying the yellow of the bands and other scale characters such as overlying black scales or replacement of yellow scales by white scales; whether or not the lower yellow band of the forewing was interrupted by patches of black scales on the under surface. The date of capture and locality of each specimen were entered but are not here recorded in detail.

DISCUSSION

The data from the samples show that these represent eight distinct populations of *Heliconius charitonius*. Although no material was available for study, a ninth population is recognized as possibly distinct, that of St. Kitts, Antigua, and Montserrat. These nine populations appear to be in two groups with a connecting population. There are broad, yellow bands on the hind wings associated with short forewings, all from Antillean populations (fig. 3A-C). There are narrow bands on the hind wings mostly associated with long forewings, from Hispaniola, Florida, and the continent (fig. 3E-H). The Cuban population lies between the two groups, for it has broad bands and long forewings

(fig. 3D). The broad bands extend well below the discal cells of the hind wings, while the narrow bands may cut into them, as in the Floridian population, or be but little below them, as in some other populations.

The populations of the various Virgin Islands, Puerto Rico, and Mona Island, hereafter referred to as the Virgin Islands race, show a considerable individual variation between examples in any one locality as judged by the preparatory statistics of the samples. The extensions of the yellow areas (table 3, A, C, D, F) are nearly twice as prominent in examples from the various Virgin Islands as in examples from Puerto Rico. Notwithstanding, the samples from the various areas of the region are preponderantly so similar that there appears to be no basis for a separation of these populations. Relative to other population groups, the Virgin Islands race is small in size, with broad yellow bands on the wings, and the maculation is heavier. The Virgin Islands race is considered to be a distinct subspecies.

The examples of the population of Jamaica are of slightly smaller size than examples of the Virgin Islands race and differ in other characters. The yellow bands are relatively broader, and the band at Cu_2 of the forewing is considerably expanded distad. The yellow spots of the forewing show marked differences from the Virgin Islands race. Spots A and F occur with about half the frequency, notch B occurs with about twice the frequency, and spots C and D are obsolete. Longstaff (1912) in comment said that Jamaican specimens had larger marks as compared with examples from Venezuela. The Jamaican race appears to be a distinct subspecies.

The Cuban population, which is apparently quite uniform throughout the island, stands between the small-sized, broad-banded populations and the large-sized, narrow-banded populations, for it is of large size and broad-banded. The relative occurrence of yellow maculation is shown in table 3 and a racial variation is indicated, but another character appears, that of rusty scales over the yellow in a small percentage of females. This rusty scaling is completely absent in the samples of the previously mentioned races from the Virgin Islands and Jamaica, but it is present in all of the long-winged populations later to be discussed. The Cuban race appears to be a distinct subspecies.

Carpenter and Lewis (1943) reported the species from Grand Cayman as abundant. They noted specimens of large size, some

with "*punctata*" characters. Although no specimens from this locality have been seen, the above remarks suggest that the Grand Cayman population belongs with the Cuban race rather than with the Jamaican.

Holland (1916), reporting the species from the Isle of Pines, was less exact. He said: "They do not differ appreciably from specimens coming from other parts of the Neotropical Region." Without material from the Isle of Pines, its close proximity to Cuba would suggest that its population is probably the same as that of Cuba.

The population in the large island of Hispaniola, with a number of ecologically variable habitats, seems quite uniform judged by the relatively large sample from many localities from end to end of the island. The average size of the specimens of the sample is slightly smaller than of those of the Cuban race, but the width of the band at Cu_2 is distinctly less than in those of the Cuban race. The occurrence of the yellow spots is approximately the same, except that spot D is nearly obsolete. Females with rusty scales increase to over 50 per cent, and another character appears as a trace, that of the interruption of the yellow band with patches of black scales on the under side of the forewing. The Hispaniolan race appears to be a distinct subspecies.

The population of Florida has specimens which are larger in size than those of previously mentioned *Heliconius charitonius* races and also possess the narrowest yellow bands. The considerable series shows a broad range in individual size of examples from 25 mm. to 50 mm., and with the exception of the Mexican sample, the largest average size of any sample. The narrow yellow bands of the forewing are unusual in that in 90 per cent of the specimens, on the under side, the band is interrupted by patches of black scales, often to the extent of completely dividing it. In the Florida race over 40 per cent of the females have rusty scaling, at least to some extent, over the yellow bands. The yellow spot D is obsolete and spot F is absent. The Florida race appears to be a very distinct subspecies.

The five races previously discussed are allopatric, each isolated from the others by marine barriers. There remains for consideration the continental representatives of *charitonius* which range from Peru to the western United States.

The Mexican population represented by a suitable sample, comparable in size to that from Hispaniola, is superficially similar

to that population. Statistically it is quite different. The band at Cu_2 is wider; there is no indication of interruption of the yellow band on the under side by patches of black scales; the yellow spots A and C are considerably reduced, and spots D and F are obsolete. Over 60 per cent of the females have rusty scales, a considerable increase in this character. The Mexican population is sufficiently different from all previously discussed races to be considered a separate subspecies.

Throughout Central America from Guatemala to Panama a sample was examined for comparison with the Mexican sample. The results were slightly different, but it is evident that examples from this region differ little from the population found in Mexico. The slight shift to smaller size and slight differences in maculation may be a clinal trend towards the South American population.

The South American sample includes specimens from western Venezuela, various widespread localities in Colombia, and a lot labeled "Northeastern Peru," perhaps in the lower valley of the Marañon or even the Napo River Valley. This South American sample, although covering a wide area, is quite uniform in its characters. The sample is large enough, although weak in female specimens. It differs from all other samples of populations in that about 25 per cent of the males show more or less black overscaling on the yellow bands. About 60 per cent of the females show rusty scaling; only the Mexican and Central American samples are higher in this character. The average length of the forewing is much less than in the latter samples. As shown by table 3 there are some differences in the percentages of occurrence of the various maculations. The South American race is considered a distinct subspecies.

On the western slope of the Andes there occurs a race of *charitoni* greatly different from all other populations. This is represented by samples from Lima, Peru, San Rafael, and Guayaquil to Quito, Ecuador. It is the smallest of the races and distinctive in appearance, although the same elements of pattern are preserved. The yellow band at Cu_2 of the forewing is one-third shortened distally and broadest at the point of measurement of any of the races. The yellow band of the hind wing is narrow, as in other continental races. Usually these bands are yellow throughout, but five females have white distal extremities to these bands. The middle band of the forewing is yellow in about half of the specimens, otherwise white. All other maculation, nor-

mally yellow in *charitonius*, is white, producing a strikingly different subspecies.

From table 4 it can be noted that occasionally a male occurs with rusty scaling and that black overscaling occurs rarely in both sexes in other than the South American sample. Albinism, pronounced in the race of the western slope of the Andes, is also noted in other races sparingly in both sexes, being partial in all except for one male from Florida where the yellow coloring on both surfaces is completely replaced by white.

TABLE 4
MISCELLANEOUS DATA ON SCALE COLOR

	Rusty	Black Scales		White Scales	
	♂	♂	♀	♂	♀
Virgin Is. and Puerto Rico	1	0	0	0	0
Jamaica	1	0	0	0	0
Cuba	0	0	0	1	0
Hispaniola	1	2	0	0	1
Florida	0	0	2	4 ^a	0
Mexico	1	0	0	0	0
Central America	1	0	0	0	0
South America	0	20	0	1	0
West slope of Andes	0	9	4	22	17

^a One male completely white, three males with some white scales.

TAXONOMY

Heliconius charitonius charitonius (Linnaeus)

Papilio charithonia LINNAEUS, 1767, p. 757. "America."

Papilio charitonias LINNAEUS, 1767, index.

The male type of *charitonias* is in the collection of the Linnaean Society of London and is illustrated in figure 2. With the type known, it is possible by elimination to fix its place of origin with reasonable accuracy. The type definitely belongs to the Virgin Islands race, and it probably came from the island of St. Thomas, Virgin Islands. This was discussed by Comstock (1944) where it was pointed out that Linnaeus included by reference a specimen from Montserrat (Edwards, 1746, p. 80, pl. 80) and a specimen from Jamaica (Sloane, 1725, p. 217, pl. 239, figs. 15, 16). Both of these specimens and the type specimen of *charitonius* belong to the small-sized, narrow-banded, Antillean group. At that time (1944) this group was not studied fully, and only the

St. Kitts population, named *punctata* by Hall, was separated. Now the populations of the islands of St. Croix, St. Thomas, St. John, and Tortola in the Virgin Islands, Puerto Rico, and Mona Island are included as belonging to the nominate subspecies, *Heliconius charitonius charitonius* (Linnaeus). In these populations about 40 per cent of the specimens from the Virgin Islands show the macular characters of *punctatus*. In Puerto Rico these characters appear, at least to some extent, in 25 per cent of the specimens. Figure 3A shows a specimen from St. Thomas which has the typical maculation of *charitonius punctatus* while figure 3B, also from St. Thomas, is typical of *charitonius charitonius*.



FIG. 2. The Linnaean type of "Charithonia," a male, in the collection of the Linnaean Society of London, photographed by Mr. Cyril F. dos Passos.

***Heliconius charitonius punctatus* Hall**

Heliconius charithonia punctata HALL, 1936, p. 276. St. Kitts.

Hall said in his description: "♂ ♀ Differs from the widely distributed typical race in the presence of an additional yellow spot in cellule 3 [lying on vein Cu_1] of the forewings. This spot varies from a mere dot to a maximum length of 8 mm. and breadth of 2 mm., and is only absent in one out of nearly a hundred specimens captured. There is also a tendency for the oblique discal



FIG. 3. Left, broad-banded Antillean races. Right, narrow-banded races. (Explanation on opposite page.)

band to extend slightly below vein 4 [M_3], and there is a marginal dot above the end of that vein and an additional dot below the distal end of the long basal stripe.

"Habitat.—St. Kitts; a long series.

"Antigua, 1 ♀ in the British Museum."

With no material for examination, Hall's definition of this subspecies is accepted, and Montserrat is added to his localities on the basis of Edwards's (1746) figure.

The genetic influence producing heavy maculation seems to be dominant in the southern Antillean range of the species for, as noted above, it is much in evidence in the Virgin Islands but less so in Puerto Rico. In Jamaica this influence is reduced particularly in the loss of spots C and D. In Cuba spots C and D are much more prevalent, and in Hispaniola spot C appears in about one-third of the examples, with spot D obsolete.

Heliconius charitonius simulator Röber

Heliconius simulator RÖBER, 1921, p. 4. Jamaica.

Röber described this Jamaican race as a new "Art oder Form" from one female from Jamaica. He compared his specimen with 14 specimens from the Cauca Valley in Colombia, a quite different population but not, as he assumed, representative of nominate

EXPLANATION OF FIGURE 3

A. *Heliconius charitonius charitonius* (Linnaeus). Male. St. Thomas, Virgin Islands, November 23, 1925. This specimen shows the characteristics of *Heliconius charitonius punctatus* Hall.

B. *Heliconius charitonius charitonius* (Linnaeus). Male. Charlotte Amalie, St. Thomas, Virgin Islands, March 14, 1929. F. M. Brown, collector. This specimen is probably topotypical.

C. *Heliconius charitonius simulator* Röber. Male. Montego Bay, Jamaica, December 10, 1938. F. E. Church, collector.

D. *Heliconius charitonius ramsdeni*, new subspecies. Paratype, male. Palmarito, Oriente, Cuba. July, 1926.

E. *Heliconius charitonius churchi*, new subspecies. Paratype, male. Port-au-Prince, Haiti, February 8, 1933. H. W. Schroeter, collector.

F. *Heliconius charitonius tuckeri*, new subspecies. Paratype, female. Florida City, Florida, April 5, 1938. Mrs. L. E. Forsyth, collector.

G. *Heliconius charitonius vazquezae*, new subspecies. Paratype, male. Pajaritos, Vera Cruz, Mexico, August, 1944. M. Guerra, collector.

H. *Heliconius charitonius bassleri*, new subspecies. Paratype, male. North-eastern Peru. H. Bassler, collector.

charitonius. The characteristics of *simulator*, previously discussed, are defined in tables 1 to 4, under Jamaica.

***Heliconius charitonius ramsdeni*, new subspecies**

HOLOTYPE, MALE: Matanzas, Cuba, August; Wm. Schaus, collector.

Length of left forewing, 41.2 mm.; width of band at vein Cu_2 , 2.5 mm.; width of band of hind wing, 3.4 mm. Notch B present; spot C, trace; spot E present. The size is slightly larger than the arithmetical average for males of the Cuban population sample but less than the maximum size; the width of the band at Cu_2 is slightly less than the arithmetical average for males but much greater than the minimum width. The markings fall within the range for specimens of the Cuban population.

ALLOTYPE, FEMALE: San Carlos Estate, Guantanamo, Cuba, June 17; the American Museum of Natural History expedition.

Length of left forewing, 44.6 mm.; width of band at vein Cu_2 , 3.0 mm.; width of band of hind wing, 3.8 mm. Bar A present; notch B present; spot D, trace; spot E present; spot F, trace. The size is larger than the arithmetical average for females of the Cuban population sample but less than the maximum size; the width of the band at Cu_2 is greater than the arithmetical average for females but less than the maximum width. The markings approach the maximum but fall within the range for specimens from the Cuban population.

PARATYPES: Forty-two males and 45 females, all from Cuba, coming within the range of the characteristics as tabulated in tables 1 to 4, under Cuba.

Named for Dr. Charles Theodore Ramsden, student of the fauna of Cuba.

***Heliconius charitonius churchi*, new subspecies**

HOLOTYPE, MALE: Port-au-Prince, Haiti, December 30-31; the American Museum of Natural History expedition.

Length of left forewing, 38.7 mm.; width of band at vein Cu_2 , 2.2 mm.; width of band of hind wing, 2.6 mm. Notch B present; spot C, trace; spot E present. The size is about the same as the arithmetical average for males of the population sample from Hispaniola; the width of the band at Cu_2 is slightly greater than the arithmetical average for males. The markings fall within the range for specimens of the Hispaniolan population.

ALLOTYPE, FEMALE: Sanchez, Dominican Republic, June 24 to July 4; the American Museum of Natural History expedition.

Length of left forewing, 43.0 mm.; width of band at vein Cu_2 , 2.1 mm.; width of band of hind wing, 2.8 mm. Bar A, trace; notch B present; spot C, trace; spot E present; yellow bands mostly overlain with scales of rusty color. The size is slightly greater than the arithmetical average for females of the population sample from Hispaniola; the width of the band at Cu_2 is slightly less than the arithmetical average. The markings approach the maximum but fall within the range for specimens of the Hispaniolan population.

PARATYPES: Seventy-eight males and 73 females, all from Hispaniola, coming within the range of the characteristics as tabulated in tables 1 to 4, under Hispaniola.

Named for Mr. Frederic E. Church, artist and collector of *Heliconiinae*.

Heliconius charitonius tuckeri, new subspecies

HOLOTYPE, MALE: Winter Park, Florida, October 4; A. B. Klots, collector.

Length of left forewing, 41.2 mm.; width of band at vein Cu_2 , 1.5 mm.; width of band of hind wing, 2.6 mm. Notch B, trace; spot E present; yellow band at Cu_2 interrupted by black scaling completely on under side and partly so on upper side. The size is approximately at the arithmetical average for males of the population sample from Florida; the width of the band at Cu_2 is somewhat less than the arithmetical average. The markings fall within the range for specimens of the Floridian population.

ALLOTYPE, FEMALE: Key Largo, Florida, July 15; A. B. Klots, collector.

Length of left forewing, 43.2 mm.; width of band at vein Cu_2 , 1.6 mm.; width of band of hind wing, 2.0 mm. Bar A, trace; notch B present; spot E present; yellow band at Cu_2 interrupted by black scaling slightly on under side; yellow bands partly overlain with scales of rusty color. The size agrees with the arithmetical average for females of the population sample from Florida; the width of the band at Cu_2 is near the minimum. The markings fall within the range for specimens of the Floridian population.

PARATYPES: One hundred and twenty-five males and 99 females,

all from Florida and Georgia, coming within the range of the characteristics as tabulated in tables 1 to 4, under Florida.

This subspecies was named at the request of Dr. Alexander B. Klots for the Reverend and Mrs. Royal Tucker of Winter Park and Crescent City, Florida, because of their hospitality to a working entomologist.

***Heliconius charitonius vazquezae*, new subspecies**

HOLOTYPE, MALE: Campeche, Campeche, Mexico, November; M. Guerra, collector; Frank Johnson, donor.

Length of left forewing, 41.5 mm.; width of band at vein Cu_2 , 2.4 mm.; width of band of hind wing, 3.0 mm. Notch B present, spot E present. The size is at the arithmetical average for males of the population sample from Mexico; the width of the band at Cu_2 is slightly greater than the arithmetical average. The markings fall within the range for specimens of the Mexican population.

ALLOTYPE, FEMALE: Allende, Vera Cruz, Mexico, July; M. Guerra, collector; Frank Johnson, donor.

Length of left forewing, 46.5 mm.; width of band at vein Cu_2 , 2.8 mm.; width of band of hind wing, 3.3 mm. Bar A, trace; notch B present; spot E present; yellow bands moderately overlain with scales of rusty color. The size is about halfway between the arithmetical average and the maximum size for females of the population sample from Mexico; the width of the band at Cu_2 is somewhat greater than the arithmetical average. The markings fall within the range for specimens of the Mexican population.

PARATYPES: Eighty-four males and 53 females, all from Mexico and Texas, coming within the range of the characteristics as tabulated in tables 1 to 4, under Mexico. The three Texas specimens are: one male, Sarita, Willacy County; one female, Corpus Christi, Nueces County; one female, New Braunfels, Comal County.

Named for Miss Leonila Vázquez G., student of the Lepidoptera of Mexico.

***Heliconius charitonius bassleri*, new subspecies**

HOLOTYPE, MALE: La Providencia, Carretera al Mar, Cauca, Colombia, 1300 meters, September; K. von Sneidern, collector; Frank Johnson, donor.

Length of left forewing, 38.4 mm.; width of band at vein Cu_2 , 2.3 mm.; width of band of hind wing, 2.5 mm. Notch B present;

spot E present; yellow bands moderately overlain with scales of black or dark brown color. The size is slightly greater than the arithmetical average for males of the population sample from South America; the width of the band at Cu_2 is slightly greater than the arithmetical average. The markings fall within the range for specimens of the South American population.

ALLOTYPE, FEMALE: Río Cocorna, Antioquia, Colombia, 800 to 1100 meters, August; L. Richter, collector; Frank Johnson, donor.

Length of left forewing, 42.0 mm.; width of band at vein Cu_2 , 2.5 mm.; width of band of hind wing, 2.7 mm. Notch B, trace; spot E present; yellow bands heavily overlain with scales of rusty color. The size is slightly less than the maximum for females of the population sample from South America; the width of the band at Cu_2 is slightly greater than the arithmetical average. The markings fall within the range for specimens of the South American population.

PARATYPES: Seventy-five males and 21 females, all from northwestern South America, coming within the range of the characteristics as tabulated in tables 1 to 4, under South America.

Named for the late Dr. Harvey Bassler, Research Associate, the American Museum of Natural History.

***Heliconius charitonius peruvianus* C. and R. Felder**

Heliconia peruviana C. AND R. FELDER, 1859, p. 396. Peru.

The authors said that they received a pair of this species from Peru, noting that it was related to *charitonius*. Apparently, from recent records, this subspecies occurs in the coastal strip west of the Andes. Its characteristics have been defined previously and are summarized in tables 1 to 4.

GENITALIA

Eltringham (1916) considered the classification of the genus *Heliconius* from an examination of the male genitalia, especially the claspers of the male organs. His figures were not particularly informative except for the differentiation of groups. This pioneer attempt is mainly indicative of the need of further intensive study of this apparently complex group of butterflies from the standpoint of structure.

For the purposes of this paper, to satisfy the query as to the specific uniformity of *charitonius*, genitalic preparations were

made of all the subspecies except *punctatus*. All preparations showed consistent uniformity of structure. Preparations of *Heliconius charitonius peruvianus* C. and R. Felder were indistinguishable from those of any other subspecies of *charitonius*. An examination of some of the red-banded species of *Heliconius* showed characters of genital structure which were abundantly distinct.

ACKNOWLEDGMENTS

To obtain satisfactory results from a study of the kind undertaken, it was desirable, in fact necessary, to have reasonably large samples of each population for examination. To accomplish this end and thus supplement the American Museum series, loans were obtained from several institutions and from a number of private collections.

From the Museum of Comparative Zoölogy at Harvard College, through the courtesy of Mr. V. Nabokov, good samples were obtained from Jamaica, Hispaniola, and particularly Cuba, with a scattering of others—a total of 134 specimens.

The Reading Public Museum and Art Gallery, through the courtesy of Mr. Lawrence S. Dillon, lent a total of 57 specimens from five different populations, providing particularly useful series from the Virgin Islands and Central America.

Cornell University, Department of Entomology, through the courtesy of Dr. W. T. M. Forbes, lent specimens from St. Croix, Virgin Islands, and a good series of *peruvianus* from Lima, Peru—a total of 55 specimens.

From the Department of Biology of the Agricultural and Mechanical College of Texas, through the courtesy of Mr. Lawrence S. Dillon, nine specimens were lent, including three captured in Texas.

Of the loans from private collections, that from Mr. F. E. Church was the most varied, containing examples from six populations in a total of 39 specimens.

Examples from Florida were lent by Mr. Otto Buchholz, 12 specimens; Dr. Ralph L. Chermock, 29 specimens; Mr. Cyril F. dos Passos, 42 specimens; Dr. Alexander B. Klots, 49 specimens.

Through correspondence, assistance is acknowledged from Messrs. Ralph L. Chermock, Austin H. Clark, Lawrence S. Dillon.

William D. Field, Wm. T. M. Forbes, H. A. Freeman, V. Nabokov, and Don B. Stallings.

The holotypes and allotypes of the new subspecies are in the collection of the American Museum of Natural History. The remaining specimens of each sample, where they are new subspecies, are made paratypes. All specimens used in this study have printed determination labels affixed.

BIBLIOGRAPHY

BATES, HENRY WALTER

1862. Contributions to an insect fauna of the Amazon Valley, Lepidoptera, Heliconidae. Trans. Linnaean Soc. London, vol. 23, pp. 495-566, pls. 55-56.

BOISDUVAL, JEAN ALPHONSE, AND JOHN EATTON LECONTE

- 1829-1833. Histoire générale et iconographie des lépidoptères et des chenilles de l'Amérique Septentrionale. Paris, pp. i-iv, 1-228, pls. 1-78.

BUTLER, ARTHUR GARDINER

1901. On some butterflies from St. Lucia, W. Indies, collected by Major A. H. Cowie, R.E., F.Z.S. Proc. Zool. Soc. London, 1901, vol. 2, pp. 711-714.

CAPRONNIER, J. B.

1873. Notice sur les époques d'apparition des lépidoptères diurnes du Brésil. Ann. Soc. Ent. Belgique, vol. 17, pp. 7-39, 61-62, pl. 1.

CARPENTER, G. D. HALE, AND C. B. LEWIS

1943. A collection of Lepidoptera (Rhopalocera) from the Cayman Islands. Ann. Carnegie Mus., vol. 29, pp. 371-396.

COMSTOCK, WILLIAM PHILLIPS

1944. Insects of Porto Rico and the Virgin Islands, Lepidoptera, Rhopalocera. Scientific Survey of Porto Rico and the Virgin Islands, New York Acad. Sci., vol. 12, pt. 4, pp. 421-622, text figs. 1-29, pls. 1-12.

CRAMER, PIERRE, AND (IN PART) CASPAR STOLL

- 1777-1791. Papillons exotiques des trois parties du monde. Amsterdam, vol. 2 (1777), pp. 1-151, pls. 97-192; supplement (Stoll, 1787-1791), pp. i-viii, 1-184, pls. 1-42.

EDWARDS, GEORGE

- 1747-1751. A natural history of birds. London, vol. 2, pp. i-xxiii, 1-126, pls. 1-105.

Title page dated 1802; plates dated 1739-1746.

ELTRINGHAM, HARRY

1916. On specific and mimetic relationships in the genus *Heliconius*, L. Trans. Ent. Soc. London, pp. 101-148, pls. 11-17.

FELDER, CAJETAN, AND RUDOLF FELDER

1859. Lepidopterologische Fragmente. Wiener Ent. Monatschr., vol. 3, pp. 390-405, pls. 7-9.

FIELD, WILLIAM D.

1938. A manual of the butterflies and skippers of Kansas. Bull. Univ. Kansas, biol. ser., vol. 39, no. 10, pp. 1-328.

GMELIN, JOHANN FRIEDERICH
(See Linnaeus.)

GODMAN, FREDERICK DUCANE, AND OSBERT SALVIN

1879-1901. *Biologia Centrali-Americana. Insecta, Lepidoptera-Rhopalocera*. London, vol. 1 (1879-1886), pp. i-xlvi, 1-487, pls. 1-42; vol. 2 (1887-1901), pp. i-iii, 1-782, pls. 43-112.

Godman only after vol. 2, p. 456, and pl. 90.

1896. On the butterflies of St. Vincent, Grenada and the adjoining islands of the West Indies. *Proc. Zool. Soc. London*, pp. 513-520.

HALL, ARTHUR

1936. The butterflies of St. Kitts. *Entomologist*, London, vol. 69, pp. 274-278.

HOLLAND, WILLIAM JACOB

1916. The Lepidoptera of the Isle of Pines, being a list of the species collected on the island by Mr. J. L. Graf and Mr. G. A. Link, Sr., in 1910 and 1912-1913. *Ann. Carnegie Mus.*, vol. 10, pp. 487-518, pl. 31.

1931. The butterfly book. Garden City, New York, Doubleday, Doran and Co., Inc., pp. i-xii, 1-424, text figs. 1-198, pls. 1-77.

KAYE, WILLIAM JAMES

1921. A catalogue of the Trinidad Lepidoptera, Rhopalocera. *Mem. Dept. Agr. Trinidad and Tobago*, no. 2, pp. i-xii, 13-163, pl. 1.

LATHY, PERCY I.

1904. A contribution towards the knowledge of the Lepidoptera-Rhopalocera of Dominica, B. W. I. *Proc. Zool. Soc. London*, 1904, vol. 1, pp. 450-454.

LINNAEUS (CARL VON LINNÉ)

1767. *Systema naturae. Editio duodecima reformata*. Stockholm, vol. 1, pt. 2, Lepidoptera, pp. 744-900.

1774. Des Ritters Carl von Linné... *Vollständiges Natursystem*. Nuremberg, P. L. S. Müller, vol. 5, pp. [1-14], 1-758, pls. 1-22.

1776. A catalogue of the birds, beasts, fishes, insects, plants, etc., contained in Edwards's natural history, in seven volumes, with their Latin names. London, pp. [1-6], 7-15.

1790. *Caroli a Linné... Systema naturae etc.*, ed. decima tertia, cura J. F. Gmelin. Leipzig, vol. 5, pp. 2225-3020.

LONGSTAFF, GEORGE BLUNDELL

1908. On some of the butterflies of Tobago. *Trans. Ent. Soc. London*, pp. 53-57.

1912. Butterfly-hunting in many lands. London, pp. i-xviii, 1-728, text figs. 1-19, pls. 1-6, frontispiece, app. pls. A-J (9).

MÜLLER, PHILIPP LUDWIG STATIUS
(See Linnaeus.)

REIZENSTEIN, LUDWIG VON

1863. Catalogue of the Lepidoptera of New Orleans and its vicinity. New Orleans, Isaac T. Hinton, pp. 1-12.

RÖBER, JOHANNES

1921. Ueber bekannte und neue Schmetterlinge. *Ent. Rundschau*, vol. 38, pp. 4-5.

SEPP, JAN

1828–1855. *Surinaamsche Vlinders*. Amsterdam, vol. 2, pp. i–iv, 109–224, pls. 51–100.

SHARPE, EMILY MARY

1900. On a collection of butterflies from the Bahamas. *Proc. Zool. Soc. London*, pp. 197–203, pl. 19.

SLOANE, SIR HANS

1725. A voyage to the islands Madera . . . St. Christopher's and Jamaica with the natural history . . . of the last of those islands. London, vol. 2, pp. i–xviii, pls. v–xi; pp. 1–499, pls. 157–274.

STOLL, CASPAR

(See Cramer and Stoll.)

